REPLACEMENT SPECIFICATION PAGES

GAS DISCHARGE LAMP DRIVE CIRCUITRY PROVIDING INDEPENDENT PULSE SERIES

BACKGROUND

a. Field of the Invention

The present invention relates to an apparatus and method for driving a gas discharge lamp, and in particular for dimmably or non-dimmably driving fluorescent lamps or tubes.

b. Related Art

Fluorescent lamps are tubes that are widely used in the home, office and in industry to provide lighting. Such lamps generally consist of a tubular glass envelope, up to 2.44 m (8 feet) long, filled with an inert gas such as krypton or argon which when electrically excited in a gas discharge irradiates a fluorescent coating, such as a powder comprising a (Tb, Ce, Gd, Mg) borate, a (Eu,Ba, Mg) aluminate and a (Y, Eu) oxide, on the inside of the glass. An example of such a tube, 1.22 m (4 feet) long, is the model 'TL'D 36 Watt sold under the trade names ``Super 80 (/840) New Generation'' and ``Standard (/33)'' by Philips Electronic and Associated Industries Limited.

All gas discharge lamps, including fluorescent lamps, require a ballast to operate. The ballast provides a high initial voltage to initiate the discharge, then rapidly limits the lamp current to safely sustain the discharge. Ballasts are manufactured for three main classes of fluorescent lamp: preheat, rapid start and instant start.

Preheat operation lamp electrodes are heated prior to initiating the discharge. A starter switch closes, permitting a current to flow through each electrode. The starter switch rapidly cools down, opening the switch, and triggering the supply voltage across the arc tube, initiating the discharge. No auxiliary power is applied across the electrodes during operation.

Rapid start operation lamp electrodes are heated prior to

amount of harmonic distortion produced by high frequency ballasts.

It is an object of the invention to provide a circuit for a high frequency ballast for a gas discharge lamp that addresses these problems and which may be dimmable, and which may be used with certain types of gas discharge lamp such as high output 2.44 m fluorescent lamps which to date have not benefited from the increased efficiencies possible with high frequency operation.

SUMMARY OF THE INVENTION

According to the invention, there is provided an electronic circuit for controlling a gas discharge lamp, comprising generation means for generating a high frequency pulse train that may be applied to the electrodes of the lamp to light the lamp, means for connecting the means for generating a high frequency pulse train to an electrical power source, a choke to limit the current drawn by the lamp, characterized in that the circuit comprises means for producing a first series of pulses and means for producing a second series of pulses independently from the first series of pulses, and means for combining additively the first and second series of pulses to produce the high frequency pulse train.

In a preferred embodiment of the invention, the circuit is for a fluorescent lamp.

The term high frequency is intended to exclude frequencies above those used for mains supply, i.e. above 50 to 60 Hz. The value of the high frequency may depend on a number of factors, in particular the type of lamp and the physical size and power rating of the lamp.

The arrangement is such that the rms power level of the high frequency pulse train is determined by the first and second series of pulses, and in particular because the series of pulses are independent of each other may be set

Preferably, this power level should be substantially constant and, in the case of the circuit for dimmably controlling the lamp, unaffected by the phase shifting of the first and second series of pulses with respect to one another.

The modulation means may vary the width of each pulse in the pulse train similarly, that is, so that the ratio of on/off time for each combined high frequency pulse is substantially the same.

It would, however, alternatively be possible to vary the width of each combined high frequency pulse in the pulse train dissimilarly, that is, so that the ratio of on/off time for at least some of the adjacent pulses in the pulse train are not substantially the same, so long as the gaps between pulses do not become so long that the pulse train becomes substantially discontinuous, so causing the tube to flicker off at lower average duty cycles.

The pulse train may comprise pulses of just one polarity, but preferably comprises pulses of both positive and negative polarity.

Circuitry such as that described above is not bulky and may readily be incorporated in a light fitting having contacts for a gas discharge lamp. Alternatively, the circuit may be separate from the light fitting, although it would be necessary to provide appropriate transmission lines, e.g. coaxial cable, and shielding to prevent stray leakage of electromagnetic radiation.

The invention will be further described by way of example to the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a schematic diagram of a circuit for

dimmably controlling a fluorescent lamp according to the invention, having a micro-controller which controls an inverter circuit connected to the lamp;

Figure 2 is a diagram of a pair of wave forms generated by the inverter circuit of Figure 1;

Figure 3 is a circuit diagram of the micro-controller of Figure 1;

Figure 4 is a circuit diagram of the inverter of Figure 1 connected to the lamp;

Figure 5 is a schematic diagram of the output from the inverter across the fluorescent lamp;

Figure 6A to 6L are photographs of oscilloscope traces showing voltages representative of the current supplied by the inverter to the fluorescent lamp, as measured using a feedback winding on the choke; and

Figures 7A to 7I are photographs of oscilloscope traces showing the voltage supplied by the inverter to the fluorescent lamp, as measured across the lamp.

DETAILED DESCRIPTION

Referring first to Figures 1 and 2, a micro-controller 1 is connected to mains electrical power and a dimmer switch 2. The micro-controller has standard circuitry for mains rectification and stabilization (not shown), and supplies an inverter circuit 3 with dc power at 320 V, in addition to low voltage dc supply V_{cc} at 5 V and three independent supplies V_{DD1}, V_{DD2} and V_{DD3} at 15 V. The inverter circuit 3 is of the rapid start type.